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ELECTRICAL IONTOPHORESIS: Special Indications and Technique.

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In Chronic rheumatism ionotherapy, and thus electrical iontophoresis, has a definite, although not very large, place. It must be remembered, however, that for so chronic and intractable a disease, even minor procedures are of great importance. The ions which possess a certain therapeutic effect in chronic rheumatism are lithium, iodine, salicylic and histamine ions.

The lithium ion possesses a definite regulatory action on uric acid metabolism, or more precisely on nucleo-protein metabolism. Even in its crude pharmaceutical form, lithium has certain therapeutic effects. In the form of ions its effects are more distinct, and clinical observations show definitely the effect of ionotherapy with lithium through electrical methods. Lithium being an electro-positive ion, it must be driven into the body through the positive electrode. The lithium solution must therefore be used at the positive pole. The active electrode is best used on the diseased joint, for by this procedure a local effect is added to the general effect. The negative electrode is placed anywhere on the surface of the body.

Lithium ionization, with a solution of lithium salicylate used on the positive pole, is therefore indicated in those chronic rheumatic conditions showing a disturbed nucleo-protein metabolism. Certain French authors, desiring to obtain a more general effect, use very large positive electrodes soaked in lithium salicylate, which they place on the abdomen.

Iodine ions are indicated in those chronic rheumatic conditions in which there is evidence of thyroid dysfunction, or in which there are certain special sclerotic reactions. Technique of application is similar to that of lithium ionization. The iodine ion is electro-negative, and thus the electrolytic solution (containing potassium iodide, for instance) is used on the negative electrode. Application of this electrode is usually local. Exceptionally it can be placed on any part of the body so as to drive in the iodine ions generally.

The salicyl ion is indicated in those chronic rheumatic conditions with intensely painful reactions. Clinical results are very encouraging, and it can be said that salicyl ionotherapy, and thus salicyl iontophoresis, is a most effective procedure. For salicyl ionization a solution of sodium salicylate is used at a strength of one per cent, and in this the negative electrode is soaked, the salicyl ion being a negative ion. The active negative electrode is usually applied to the painful joint, the positive electrode being placed anywhere on the surface of the body but usually near the negative electrode (for instance, on the opposite side of the joint). Although the application is essentially local, the action of the salicyl ion is essentially general. We know the effects of sodium salicylate in chronic

rheumatism and of the salicylates in general. Strong doses of salicylates, however, have disadvantages which have led to their abandonment save in conditions of acute rheumatic fever. The salicyl ion appears to be the active ingredient, and through ionotherapy good results can be obtained. The salicyl ion acts on the mid-brain and probably stimulates immunity resistance through this vegetative nervous action.

Histamine ionotherapy is the last-comer to the ionotherapy of chronic rheumatism, and here again iontophoresis offers a method of introducing the histamine ion. A one in a thousand solution of histamine acid phosphate is used with the positive pole, but only for a few minutes. The mechanism of action of histamine ionotherapy is quite different from that of the foregoing ions. In histamine ionotherapy there is predominantly a local action. After a few minutes of application there is intense skin hyperaemia. Soon wheals appear and the whole area is turned into a patch of urticaria. At the same time the temperature of the treated part of the skin rises by two or three degrees. The skin does not return to its normal appearance for some five or six hours. Simultaneously there may be some general effects, consisting principally in giddiness and malaise, and in a fall of blood pressure.

It is predominantly the local effects that explain the therapeutic action of histamine ionization. The procedure is one which has become familiar in physical medicine, a procedure of counter-irritation, as our ancestors called it, or of reflexotherapy, to employ modern terminology. By means of strong local action therapeutic reflexes are initiated.

Unfortunately, histamine ionization is often unpleasant because of the general reaction. For this reason J. Kovacs and R. Kovacs have replaced histamine by choline compounds, which they found less irritating. They use acetyl-beta-methyl-choline chloride in a solution of one-half to one per cent. This drug is employed to moisten thoroughly asbestos fabric paper, which is used as an electrode. Kovacs reports that there are no unpleasant after-effects, but that, following treatment there is clinically usually a marked relief of pain and a feeling of comfort in the afflicted parts. In cases of joint affection there is reduction of swelling and increased mobility. Iontophoresis with this compound can be prolonged for fifteen to twenty minutes.

It is to be remarked that, for application of histamine and choline compounds, special electrodes must be used. The usual pad is replaced by a reinforced asbestos fabric paper. This has the advantage of absorbing sufficient fluid, keeping moist for a long time and not disintegrating in the course of treatment.

Electrical iontophoresis can be applied in all forms of chronic rheumatism showing the individual reactions already described. It can be employed in fibrositis, in lumbago, and in gonococcic arthritis. In the latter condition it has proved extremely effective.

#### NEURITIS AND NEURALGIA

In neuritis with painful reactions, and particularly in what we call neuralgia, ionotherapy has a prominent place, and thus iontophoresis should be used more widely than it is at present. The effective ions in such cases are aconite ions, salicyl ions, and the calcium ions.

The aconite ion is one of the most interesting. Aconite, as is well known, has been used since very early days for treatment of neuralgia, and by certain physicians is considered more or less as specific for trigeminal neuralgia. Unfortunately its use is restricted, in the usual doses, by its intense toxicity. By introducing ionized aconite into the body we use a less toxic form of the drug, and one which is probably as effective. Ionootherapy with aconite, and thus iontophoresis with a solution of nitrate of aconitine is indicated in intense neuralgias, particularly trigeminal neuralgia. The method is delicate, however, for even in the small ionized doses, aconite may be toxic. It needs, therefore, very careful supervision and short treatments, at all events at first. As technique has not yet been perfected it is better for the general practitioner not to use this mode of ionotherapy.

Marais uses a solution of two milligrams per thousand. Juster and Lemon use 20 milligrams per thousand. They have treated 15 cases of trigeminal neuralgia by this method, and of them many had undergone alcohol injection treatment. The strength of the current used by these authors was about 40 to 60 milliamperes, but the intensity was always lowered towards the end of the treatment, for applications were accompanied by giddiness. Duhom has obtained equally good results.

Aconite, being a positive ion, is driven into the body by the positive electrode. This electrode is applied locally and, as this treatment is usually employed for trigeminal neuralgia, the electrode is of such a form as to make contact with half of the face, i.e., a kind of half-mask.

The salicyl ion is driven into the body and locally into the nerve by the negative electrode, the solution employed being sodium salicylate. Leduc, who introduced electrical iontophoresis and was a master of its technique, said that the analgesia produced by salicyl iontophoresis could be compared to that of an injection of morphine. Although this view may be an exaggeration, there is no doubt that salicyl ionotherapy in neuralgia has a powerful sedative effect on pain.

In all forms of neuralgia—ophthalmic, trigeminal and intercostal—iontophoresis with salicyl ions is a valuable method which deserves wider use in place of the numerous toxic and habit-forming analgesic drugs.

The quinine ion can be used and introduced by the positive pole. The technique is the same as the general technique for other iontophoretic applications. It seems to possess not only a sedative action on pain but also a general tone action on the nervous system.

Calcium and iodine ions can also be used. On the whole they are less effective than the preceding ones, although the calcium ion, used cerebrally according to the technique to be indicated, is valuable in certain cases of trigeminal neuralgia.

#### HEMIPLEGIA

Bourguignon introduced calcium ionization into the treatment of hemiplegia. It has given very good results at the great neurological clinic of the Salpetriere. He uses a 1% solution of calcium chloride in which the positive electrode is soaked. This electrode is applied to the eye on the opposite side to that of the hemiplegia. The patient must have his eyes shut. The negative electrode measuring about 2 or 3 square inches, is placed at the back of the neck, on the

occipito-vertebral interspace. The intensity of the current should remain within the limits of 2 to 5 milliamperes. It is unnecessary to repeat what has been given as the general rule for galvanic current as well as for iontophoresis, but it should be applied even more strictly in these cases. The current should originate from electric piles and never from apparatus branching from the town sector. Treatment lasts about half an hour. Each series of treatment is composed of 15 applications. The first six are given every day, the last nine every other day. After an interval of three weeks a second course of 15 is given in the same manner. This also is followed by an interval of three weeks, after which a third and even a fourth course can be given.

The observations of Bourguignon are distinctly favorable. Calcium iontophoresis has a particularly good influence on muscle spasm and on pain. Paralytic phenomena show less relief. The more appropriate cases are hemiplegias which are due to a lesion in the peduncular region in the pons or the medulla oblongata. Hemiplegias of cortical or sub-cortical origin, which unfortunately are the most frequent, are less susceptible to the influence of calcium ionization.

In a condition so intractable as hemiplegia this method merits consideration.

#### SCARS

Iontophoresis, particularly with chloride ions, is very valuable in the treatment of scars. A solution of 1% sodium chloride is used to soak gauze arranged in 16 layers. This is applied to the scar and connected to the negative pole. The intensity of the current depends on the size of the active electrode, and may range from 2 to 20 milliamperes. The meter reading is gradually increased according to the sensations of the patient up to tolerance: on an average, one milliampere per square inch of the active electrode. The flow of current, however, must always be within comfortable toleration, but it must be remembered that sensory disturbances over scars are frequent and that great care is, therefore, necessary. Otherwise electrolytic burns may occur and cause slow-healing ulcers. The sensitivity of the patient must thus be tested to see whether he can perceive any burning sensation at the site of the scar or not. Extensive reddening in a circumscribed area is a sign of excessive current, and may indicate the beginning of a burn. The average duration of treatment is half an hour; it should be followed by massage, manipulation or vibration, according to Kovacs. Treatment may be given daily or every other day, according to the condition.

Beneath the pad soaked in common salt solution the galvanic current liberates chloride ions and forms sodium hydroxide. As this substance is mildly caustic, it softens and often entirely dissolves light superficial scars. It also loosens tense and heavy scars, and renders them more amenable to mechanical stretching, massage and manipulation. According to Cumberbatch, another mechanism of action must be considered. This is due to the galvanic current as such, not to chloride iontophoresis. It is known that water increases in the vicinity of the negative pole and diminishes in the neighborhood of the positive pole. This, at all events, in a non-living conductor. The phenomenon is known as cataphoresis. It is, therefore, possible that the softening of the scar tissue may be due to an increase of water within it, since the negative pole is the active electrode.

The mechanism of action, therefore, of what is called chloride iontophoresis is not understood clearly, but the clinical results are very distinct. The technique is, of course, delicate and is one of the methods to be applied by a special dermatologist.

## ULCERS OF THE SKIN

In ulcers of the skin iontophoresis with zinc ions has an important place. Technique should be followed accurately. Scabs or sloughs must first be removed. The base and edges must be swabbed with water to wash away any discharge. A lint pad soaked in a zinc sulphate solution is applied so as to cover the ulcer. Contact should be uniform, and no part should remain uncovered. The physician should cover by means of flocculent cotton wool, applied with a small forceps, all parts not covered by the electrode, and the whole should be soaked with the zinc sulphate solution.

The mechanism of action of zinc ions, derived from a solution of zinc sulphate, is as follows: The zinc ion migrates to the intercellular fluid, forming zinc phosphate or zinc carbonate with the phosphorus or carbonic ions it meets, and zinc albuminate with proteins. Thus the method is not really ionotherapy, because the zinc no longer exists in an ionized state. At all events the insoluble zinc salts, principally zinc albuminate, form a tenacious protective covering and through the chemical action of the zinc precipitation, microbes are killed. The result is a local germicidal effect and devitalization of tissue. The thin or heavy slough leads to slow separation of detritus and formation of healthy new granulation tissue. It can be said, therefore, that iontophoresis has the same action as a caustic, but its action is far deeper and reaches all the recesses of infected cavities which cannot be touched by the usual caustics. In properly selected cases one or two treatments may advance the healing of superficial ulcers and wounds with surprising rapidity.

Zinc ions are, of course, introduced by the positive pole. Instead of these ions, copper or salicyl ions can be used, but zinc seems superior to all other ions for those cases.

## HAY FEVER

Professor Demetriades (now of Athens), working at the Laryngological Clinic at Munich, wrote in 1927 of treatment of vasomotor disturbances of the nose by iontophoresis, and thus about the treatment of hay fever. This method was immediately taken up in America, and, in this country, Mr. Philip Franklin has done much to develop the technique and indications. It is applied currently in various London hospitals.

Since the first paper of Demetriades all those who have used the method have reported good results. Such good results are not, of course, observed in all patients, nor are the effects very lasting, but nevertheless the method has proved of value.

Technique is delicate, and in fact is one of the physical methods that the otolaryngologist must use himself. The nasal cavity, according to the technique of Franklin, after cocaineization, is packed with lint or cotton wool soaked in a zinc sulphate solution. This is connected with the positive electrode. The object is to introduce zinc ions into the mucous membrane of the nose. A moist pad electrode is suitably placed and connected with the negative pole or is simply held in the hand. Current of comfortable toleration is employed and maintained for ten minutes to half an hour, according to the pathological changes present. Zinc ions cause a greyish white discoloration of the tissues to appear, and the extent of this discoloration enables the operator to gauge the efficacy of treatment.

The accepted mechanism of action of this treatment is very interesting. As has been seen in the case of zinc ionization, the zinc ion exerts a local caustic action, owing to production of zinc albuminate and zinc in soluble form. Zinc ionization, therefore, consists in cauterization of the nasal mucosa.

About 25 years ago a French otolaryngologist, Bonnier, working in the clinic of Professor Dieulafoy, demonstrated that, by cauterizing the nasal mucosa, particularly in certain regions, far-reaching therapeutic effects could be obtained. This was easily explained by the physiologists particularly after the advance in knowledge of the vegetative nervous system, through the mechanism of nervous vegetative or sympathetic reflexotherapy. The mucous membrane of the nose is rich in nervous terminations. Its cauterization, whether by the cautery of Bonnier or with zinc ionization, determines reflexes which react therapeutically in various conditions, especially in conditions of the vegetative nervous system and thus in vasomotor conditions of the nose such as hay fever. As is well known, this method has been used with great publicity, which enhances its power of suggestion, and to a very wide extent, and is known by the term sympathico-therapy. Zinc ionization is a rational form of sympathicotherapy. When it is remembered that one of the practitioners of sympathicotherapy, the Spaniard, Azuero, dealt with thousands of patients who thronged his consulting rooms and even crowded the road he lived in, one realizes that there is definitely something in the procedure.

#### ULCERATIVE COLITIS

Burnford introduced zinc ionization into the treatment of ulcerative colitis. A special flushing electrode is used, and the ionization is carried out while the zinc solution is passing into the organism. A solution of one-half per cent is employed and the current raised to the limit of tolerance. At first only a little may be tolerated with two or three milliamperes, but finally a current of twenty milliamperes may be endured for 15 minutes or longer. I do not think that this method has a very general use. In fact, for ulcerative colitis, we possess much more important therapeutic methods in dietotherapy, infrared irradiation, vaccinotherapy and other procedures, so that a procedure so unpleasant to the patient as ionization, cannot pass into general use.

#### GENERAL CONCLUSIONS

I have outlined only the principal indications for iontophoresis, confining myself to those cases which are liable to treatment by a general practitioner, with knowledge of the procedures of physical medicine. Iontophoresis has in reality very extensive indications. Many otolaryngological conditions such as antrum infections could be treated by this method in preference to more radical and often unsuccessful operations. There are also indications in the domain of dermatology and gynaecology. It would seem that iontophoresis, in which interest has revived, has a great future, for today more is known of the great therapeutic power of ions than in the days of Leduc. It should be impressed on all physicians that iontophoresis with various ions gives such good results in painful neurotic conditions that by this means, they can avoid more violent methods and the use of toxic and habit-forming analgesic drugs.

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